INTERNATIONAL DESIGN CONFERENCE - DESIGN 2010
Dubrovnik - Croatia, May 17 - 20, 2010.

DESIGN 2010

CULTURAL CUSTOMIZATION OF MOBILE COMMUNICATION DEVICES' COMPONENTS

B. Aryana and C. Boks

Keywords: culture, object oriented design, mobile communication devices, mass customization

1. Introduction

With more flexibility in technology, more segments in global markets and higher expectation of users, mass manufacturing is going to be replaced with mass customization. Modularity of mobile communication devices, and advanced manufacturing management systems make the mobile industry a good candidate for being a mass customized industry. Discussion about customization for mobile devices encompasses aspects like customization of operating systems, customization of additional software applications, customization of physical appearance, customization during usage and customization of features and components. Scope of this research is cultural customization of components, which (as it will be described later) is called static design. The next section will give a brief summary of the methodology, then in the section 3 after an introduction to mass customization discussion has been narrowed down to advantages of Object Oriented configuration systems. As explained in section 4, the mobile industry has the main characteristics of a mass customized industry. In section 4, three main aspects of culture-oriented design have been described. Section 6 will demonstrate correspondences between cultural models and elements of design. Section 7 focuses on an Integrative Approach of Culture-Oriented Design which is a unique solution among the limited number of applied solutions in this field and has a comprehensive and extendable outlook. By considering this solution in the context of the Object Oriented paradigm, a proposal for static (structural) culture-oriented design of mobile communication devices is proposed in the section 8. Section 9 discusses an experiment showing the proposal's advantages and disadvantages, and finally these findings are used for suggestions about further improvements and extensions in section 10.

2. Methodology and framework

The research presented in this paper contains two main phases. The first phase includes a theoretical discussion about connecting culture oriented design to an object oriented (OO) product model, which is usable in a mass customization system. This theoretical phase includes the following steps:

1. Exploring the current findings about mass customization, cultural models and culture oriented design.
2. Building a correspondence between an OO product model and culture oriented design of mobile communication devices.
3. Proposing a process for cultural customization of mobile communication devices, focusing on the specifications of their components and OO design.

In the next phase of the research, an experiment is used for observing the proposed process in action, using the following steps:

1. Conducting user research, using a scaled questionnaire method in order to define users' opinions or attitudes about mobile communication devices components.
2. Analyzing the results and using them in the proposed process.

At the end there is a discussion about the validity of the process by conducting another experiment about the same group of users to investigate their opinions or attitudes towards the products (not their components). The results of the theoretical discussion, experimental phase and final discussion will shape the final conclusion.

3. Mass Customization

The stereotype of mass manufacturing systems, in which limited numbers of products are being produced in high volumes for a large number of consumers can not be valid and acceptable for current customers. Today's consumers have a major influence on characteristics of products. This influence can take place in different phases of production lifecycle, especially in the wide spectrum of activities that make up the specification process and includes almost the entire life cycle of a product from product design, to use or even disposal [Hvam et al., 2008].

The broadness of this specification process means that there should be ample communication between the different parts of a manufacturing system. To make this process easier, these parts can be connected to a unified system which is called a configuration system [Hvam et al. 2008]. A configuration system defines how specifications can be applied in each phase and prevents confusing communications among different sections of the whole system. Moreover, not only the manufacturing system should be specialized for customization, but also the products must be adaptable for a customization process. The modularity enables products to be mass produced and customized at the same time. While modules can be mass produced, their combination can be customized, so the final result is a mass customized product. The existence of a configuration system and modularity of products are two main characteristics of a mass customization system. Such a configuration system can be complex and multidisciplinary and includes tasks like communication with different parts of the manufacturing system, considering the product master plan (which includes the general overview of the product's structure, available modules and the relationships between them) and managing the whole process in order to gain business advantage. In order to control and manage this complex system throughout a project lifecycle, different methods and approaches have been developed.

3.1 Application of the Object Oriented paradigm in mass customization

There are various methods for structuring a configuration system. Most of these methods use information technology in order to manage communication between different parts of the production lifecycle. This research will use one of these methods which is called Object Oriented (OO) paradigm. The OO paradigm is based on defining systems by using objects and classes data structures and was first used in software design and programming field. Application of OO paradigm in configuration systems has advantages such as modularity, maintainability and reusability [Hvam et al., 2008]. The OO paradigm can also be used for designing product variant master plans. In this way, a product and its modules are represented by a structure of classes and objects.

4. Capability of mobile communication devices for mass customization

The mobile communication devices industry has some characteristics which make it compatible for mass customization:

1. Although mobile phones (the most popular type of mobile communication devices) usually are presented in various models, they are basically modular, and are designed by using a limited number of modules.
2. Customization is not limited to the process of design, development and production of a product; it can be applied in the usage process as well. Mobile communication devices have both software and hardware (virtual and physical) components, so many of their virtual characteristics can be customized by users themselves after the purchase.

In addition to above characteristics, changes in global business models and shifts to non-western emerging markets with a high level of cultural diversity, are another reason for developing more customized mobile devices. In particular, effects of cultural differences, which is the focus of this paper, is of great importance to global players in this industry.
In this shift to (often) non-western and developing countries; global producers would face new challenges, as they are experiencing new situations which they did not meet before in regions such as Europe and North America. In these mature markets, usually countries in the same geographic area (which is a logistic area as well) have similar characteristics, but in other regions of the world situation this is not the same; for example, quite different Gross Domestic Product (GDP) scores can be seen in the same geographic areas like Middle East and South America [World Bank, 2009].

5. Importance of culture

The scope of this research is mainly the effect of culture on technology, and more specifically, the effect of users' cultural specifications on design of mobile communication devices. Relationships between culture and design have been viewed from different perspectives in literature Generally speaking, there are three main aspects which make culture an important parameter in product design.

5.1 Usability and ergonomics

Usability has been mentioned as a reason for taking culture into account. Considering the evolution process of ergonomics, from 1950s birth in the military industries to the current decade's focus on global communications, the current era can be the era of cultural ergonomics [Kaplan, 2004]. Guidelines for considering different writing systems and needed space for different alphabets on screens, different meanings for graphic symbols and motifs, availability for changing icons and texts and multicultural usability testing are examples of this attention to cultural differences in mobile usability.

5.2 Business advantages

As a driver for cultural customization, the situation of the global market for mobile devices can be noted here again: new opportunities outside mature markets in developed countries lead to more attention for user requirements in those new markets. There are also other related changes like demographic changes in the world which increase life expectancy in some developing countries, creating new consumers groups with different needs.

5.3 Social sustainability and attention to moral values

Large numbers of people around the world with different cultural backgrounds need technology to improve their life while they are not necessarily potential consumers. Also cultural differences should be considered when technology and products are being used for a sustainable growth [Christiaans & Diehl, 2007]. In general, it can be concluded that importance of culture in product design has a number of quite different aspects, from business advantage, to moral values. This variety shows that considering culture in design is not only an approach, but may also be a necessity.

6. Culture, definitions and models

Finding a certain definition for *culture* can be an impossible task. However, when it comes to defining *dimensions and models for culture*, there is a limited number of well-known cultural models. Because of their systematic approach, cultural models can be mapped to other models, such as business and management models. Some cultural models are widely used in marketing and management fields. Among these models, Hofstede's model which is originally designated for organizational behavior, has been widely used in research studies about culture in various fields, and is the most used model in studies on Human Computer Interaction (HCI) and culture relationships in recent years [Kamppuri et. Al, 2006].

6.1 Hofstede's cultural dimensions

Geert Hofstede's work is the result of one of the most comprehensives studies about culture in more than 70 countries, between 1967 and 1973 under a project supported by IBM. This study has been updated since then [Hofstede n.d.]. The main direction of his research is organizational culture, but because of the wide range of his study in all parts of the world, and also its open source numeric database on the web, it has been referred to in many other areas which deal with culture. Hofstede's model comprises five dimensions, and the results are a set of scores for each dimension, which are assigned to different countries. Definitions of these dimensions, according to the Hofstede's open source database are [Hofstede n.d., 2009]:

1. Power Distance Index (PDI): "That is the extent to which the less powerful members of organizations and institutions (like the family) accept and expect that power is distributed unequally… "
2. Individualism (IDV): "on the one side versus its opposite, collectivism, that is the degree to which individuals are integrated into groups…"
3. Masculinity (MAS): "Versus its opposite, femininity refers to the distribution of roles between the genders which is another fundamental issue for any society to which a range of solutions are found… "
4. Uncertainty Avoidance Index (UAI): "deals with a society's tolerance for uncertainty and ambiguity; it ultimately refers to man's search for Truth. It indicates to what extent a culture programs its members to feel either uncomfortable or comfortable in unstructured situations…"
5. Long-Term Orientation (LTO):" This fifth dimension was found in a study among students in 23 countries around the world, using a questionnaire designed by Chinese scholars. It can be said to deal with Virtue regardless of Truth. Values associated with Long Term Orientation are thrift and perseverance; values associated with Short Term Orientation are respect for tradition, fulfilling social obligations, and protecting one's 'face'…"

7. Culture-oriented design of human-machine systems

As an important user specification, culture has been noted in both academic and business domains of design; however the main concern is lack of systematic models and processes for considering cultural characteristics in design. While there are plenty of case studies about effects of cultural differences on artefacts or even design of some culture-specified products, it is not easy to find models or processes about connecting culture to design. Aaron Marcus provided a simple and practical solution for mapping websites' user interface components (metaphors, mental models, navigation, interaction and appearance) and Hofstede's cultural dimensions. This mapping then has been translated to a number of patterns for each cultural dimension [Marcus, 2002]. A few years later this idea has been used in a more comprehensive way by Christian Rose in the development of culture-oriented human machine systems [Rose, 2004]. The idea includes a detailed model which covers different aspects of human-machine system design together with an extendable model which is usable for different human machine systems such as products or virtual systems. In this model, intercultural variables and cultural factors (dimensions) are analyzed in a systematic process and then findings of this process (which can be different components of design) are integrated with design requirements (Figure 1).

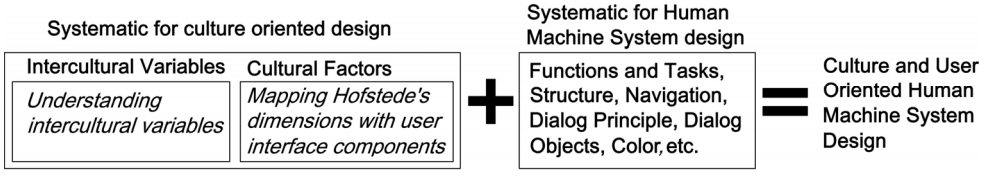

Figure 1. Integrative Approach of the Culture-Oriented Design [Rose, 2004]

There is also a focus on intercultural variables, which are defined as direct variables (information presentation, language etc.), indirect variables (general machine design, functionality) and frame variables (the educational or political system, technical standards). Another important part is a

mapping between cultural dimensions and systems' components similar to Marcus' solution. In the case of extending this approach to a product with hardware and software components such as a mobile communication device, several activities should be defined. The next section will provide a proposal for cultural customization of mobile communication devices focusing on object oriented static design, which can fit into the integrative approach of the culture-oriented design, but does not include the analyses of intercultural variables at this step. There is also a possibility for thinking about dynamic design of mobile communication devices based on cultural dimensions (for example designing usage scenarios of software and operating systems) which is not the scope of this research, however it is of great importance for further steps, in order to define a comprehensive model for considering cultural differences and also intercultural variables in design of mobile communication devices.

8. A proposal for static design of mobile communication devices, based on cultural dimensions

Although there are different methods for modelling configuration systems, modelling products and also customer need identification, finding a suitable method which can bridge all of these areas is a complex issue. This research proposes an OO paradigm for cultural customization because of the OO paradigm's simple structure, modularity and flexibility for modelling heterogeneous systems. Morover, OO thinking is a common method in mass customization, electronics and information technology. The following subsections explain the four phases of this proposal.

8.1 Static OO model of the product

A system can be modelled by the OO paradigm on static and dynamic levels. On the static level, a model usually shows the structure and components of the system, in the form of classes and their relationships, and on the dynamic level, an observer is able to see how the system works [Booch et al. 2007]. In this phase (according to the definition of OO static design) a product variant master model will be developed. This model will show all possible modules as objects which belong to certain classes. Figure 2 shows a part of the tree structure of this model.

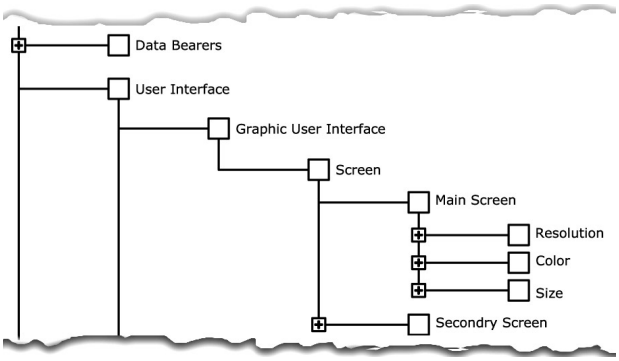

Figure 2.A part of product variant master model (tree structure)

8.2 Mapping the cultural model to the components

In the integrative approach of the culture-oriented design, a correspondence between user interface components and Hofstede's cultural dimensions was used to define the way that a state of each user interface component can be changed in a cultural context. Thinking about static design of a product (variant master model), a similar correspondence can guide designers to choose the best components; so each component can be related to a cultural dimension. In order to find these relationships, case studies can be done about target user groups. These case studies should target distinct relationships. Target users can mark scaled questionnaires to show how they think each component can be related to a cultural dimension. For instance, the question "to what extent do you think that having a Bluetooth feature can risk your privacy?" can be linked to the relationship between the "Bluetooth connectivity" component and the "uncertainly avoidance" dimension. Figure 3 shows an example of this mapping procedure. Black cells show that the component is related to the corresponding cultural dimension in

the table. Gray columns represent components that are not easily customizable, or are so technical that ordinary users have no direct interaction with them. It should be noted that the mapping in figure 3 is typical and can vary based on case studies in the different cultural contexts.

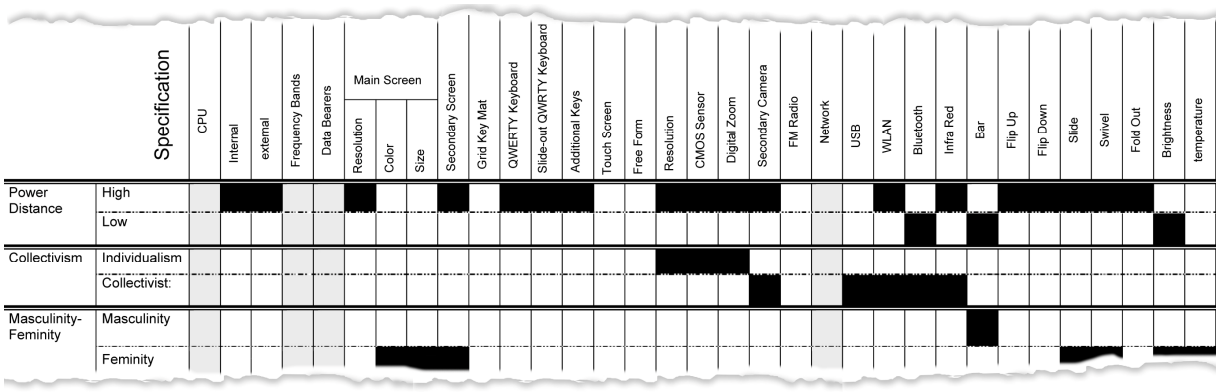

Figure 3. Mapping between hardware components and Hofstede's cultural model

8.3 Scoring components according to each component

Components which are related to each cultural dimension can have different rates of importance. For example, in a typical cultural context, "ability of reading different types of documents" ("documents / applications" component) and "flip up form factor" components can be both related to the high power distance dimension; however importance of "form factor" component may be more than"applications" component.

Therefore, the rate of importance should be considered to get optimal results in real situations, because changing all related components in a product might not be always economically feasible. The components which are related to a cultural dimension can be compared to each other, and by looking at the results of case studies, there would be some hints for understanding the main concentration of users for each dimension.

8.4 Application

Scores in 8.3 can be used in different ways. They can be used to show how a producer can customize a product for a specific cultural context, not by launching a specific product, but by modifying components of existing products. In addition, when changing a large number of components is not possible due to economic or technical limitations, the producer can focus on the most important ones to get an optimal level of customization.

9. Experiment

This experiment shows how the proposed process works in action, and also provides some clues for further improvements. The study concentrates on femininity, an aspect of the Hofstede's masculinity – femininity dimension. To make the study relevant to the selected cultural dimension, some limitations were applied to the specifications of users. Since the number of users which were studied was limited, samples were not dispersed among different clusters of the society. Therefore the results were directed to represent a limited and certain cluster of users: female users, with minimum education at bachelor level, between 25-30 years old, who live in Tehran, Iran. Iran has a medium score of masculinity in Hofstede's model which is 43. (The highest score is 110 for Slovakia, and the lowest is for Sweden which is 5)

One could say that the findings are not supportive enough to demonstrate a fact about users (for example young female mobile users in Iran), but this is not the case. Above limitations are designated based on the main goal of the experiment, which was an observation of the proposed solution, when it is applied for a specific user group, in a specific cultural context and certain cultural dimension, regardless of user group's size.

Twenty mobile phone users with above specifications filled in scaled questionnaires. In these questionnaires, each component was put against a spectrum of masculinity – femininity. Users were able to choose 3 levels of femininity (high, medium and low), 3 levels of masculinity (high, medium and low) and one neutral option. In other words, they could define to what extent each component is feminine or masculine ideas according to their opinion. Components were extracted from a product variant master model similar to the one presented in Figure 2. A part of the final results is shown in Figure 4. In this figure, each column shows a user's idea about different components. Components are categorized in two main classes of hardware and software. Further hierarchies are also drawn out from the product variant master model.

In order to define scores for each component, each level of spectrum was graded. Medium levels are graded in a way to be the average of the high and low levels, similar to their visualization in questionnaires in which they were in the middle of low and high levels. Also positive numbers were assigned for the feminine levels and negative numbers for the masculine ones. The grades are as follow:

- F3, High Femininity: 2, F2, Medium Femininity: 1.5 , F1, Low Femininity: 1
- Neutral: 0
- M1, Low Masculinity: -1, M2, Medium Masculinity: -1.5, M3, High Masculinity: -2

	Users																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Color Brightness	F1	-	F3	F1	-	F2	F2	F3	F3	F3	F1	F3	F2	F1	F3	F3	-	-	F3	F2
Color temperature	F2	F3	F3	F2	-	F3	F1	F2	F2	F1	F1	F3	F2	F3	F3	F1	-	M1	-	F3
Bar formfactor	-	-	M3	-	-	M3	M1	M3	-	F3	M1	M3	M1	-	-	M1	-	M3	-	M2
Swivel Form Factor	F1	F3	F3	-	-	F3	-	-	-	M2	F2	F3	F1	-	M3	-	-	M3	F1	F2
Slide Form Factor	-	F3	F3	F1	-	F3	F1	F3	F2	M2	-	-	M2	F2	F3	F1	-	F3	-	F1
Flip up	-	-	F3	-	-	F3	F1	-	-	F2	-	-	M2	F3	-	-	-	F3	-	-
Flip down	-	-	M3	-	-	F2	F1	-	M1	M2	-	-	F1	F3	M3	-	-	-	-	M1
Fold out	-	M3	F3	-	-	F2	F1	-	F1	M3	-	-	M2	M3	M3	-	-	-	-	M1

Figure 4. Results based on the scalar questionnaires

These grades then can be used to define femininity score for each component, by the following equation:

$$\text{Score for each component} = (2a + 1.5b + c) - (2a' + 1.5b' + c')$$

Where:

a = Number of users who have assigned a high level of femininity (F3) for the component.

B = Number of users who have assigned a medium level of femininity (F2) for the component.

C = Number of users who have assigned a low level of femininity (F1) for the component.

a' = Number of users who have assigned a high level of Masculinity (M3) for the component.

b' = Number of users who have assigned a medium level of Masculinity (M2) for the component.

c' = Number of users who have assigned a low level of Masculinity (M1) for the component.

Figure 5 shows a part of the femininity scores for the components:

	M3 -2	M2 -1.5	M1 -1	F1 1	F2 1.5	F3 2	Scores
.Color Brightness				4	4	8	26
Color temperature				4	5	7	25.5
Monochromatic Color	4	3	5				-17.5
Bar formfactor	5	1	4			1	-13.5
Swivel Form Factor	2	1		3	2	4	8.5
Slide Form Factor		2		4	2	6	16

Figure 5. Femininity score for each component

From the numbers it can be concluded that appearance is the most important aspect of femininity for users, because the highest scores belong to the colour characteristics and form factor (colour brightness has the highest score of 26. Colour temperature' score of 25.5 and slide form factor's score of 16 are placed next). Slide and flip up form factors, along with bright and warm colors are the stereotypes for a feminine mobile phone, while a bar-type (score of -13.5) and dark (usually black or gray) mobile phone which has professional and advanced features can be a stereotype for a masculine mobile phone. More advanced components, which make mobile phones closer to the concept of "mobile computing" devices (such as the presence of a QWERTY keyboard with score of -19.5), were considered as masculine components. As an example for the application of these findings, a low-cost customization for this user group may include a change of the device's color and omitting some advanced features such as Wireless LAN (Local Area Network) and document browsing applications. In this way without a major additional cost, producers can provide a more desirable product to this user group, with lower cost in comparison with the original version of the device.

10. Discussion

The experiment suggests that the proposed model has some advantages, which can be helpful in real situations. Some of these advantages are considered to be:

1. Simplicity: The solution can be applied and learned easily. Its simple algorithm can be easily used in a software system when numbers of components and cultural dimensions are high.
2. Systematic approach, which is essential for business applications.
3. Detailed information about the attitudes and opinions of users for each component.
4. All qualitative decisions (mainly deciding about drawing relationships between cultural dimensions and components) are made by users.
5. The classified structure and use of the OO product model make the solution adaptable for OO configuration systems.

However, there are some concerns about the solution as well, which are discussed below:

1. How can this solution interact with other parts of the design process?
2. In this solution, users express their attitudes and opinions about separate components. Is there any guaranty that they follow the same patterns when they deal with the combination of these components as "a product"?

Regarding the first question, currently there are a number of OO tools such as Unified Modeling Language (UML) which have predefined interfaces for dynamic and static OO design. However, the issue of aesthetic design is more complex, as compatibility of its qualitative nature with OO design is unclear. A practical solution might be a review of existing systematic methods for analysis of aesthetics in products, and changing them to usable algorithms for OO models. The second question can be answered by a sub-experiment. After answering the scaled questionnaires about components, the same respondents were asked to select a mobile phone from 6 provided alternatives. These alternatives were then graded based on their feminine components, and grades were compared with users' selections. In order to make the results more valid, the following circumstances were applied:

- Alternatives were selected form Motorola products (Figure 6), in order to decrease the effect of brand and previous experiences on users. Although Motorola is present in Iran's market, this presence is not official, because of United States sanctions. Motorola has a small market share in Iran, since about 70 percent of market is currently owned by Nokia and Sony Erikson, and in the remaining share there are other brands such as LG, Samsung and domestic producers of mobile phones [Kantar Media Research Group 2007]. So, the provided products were new to the respondents, and the effect of previous experiences or brand loyalty was limited as much as possible.
- Respondents were encouraged to read and understand the specifications of alternatives, before selecting their favorite mobile phone.
- Alternatives were selected from a specific price range (200-250 US $), so the effect of price was limited and overall capabilities of the products were similar.

Figure 6. Alternatives

Comparing the results of the phones' scores, (Table 1) with the respondents' selection shows that these two do not obey the same pattern and more desirable phones have even score lowest. Tracking respondents' answers also shows that some did not apply their opinions about individual components in their final selection. The main principle of Gestalt psychology can be a reason for this significant difference: "The whole is greater than the sum of the parts". Combination of these components as a product, along with the appearance and other aesthetic aspects can change users' preferences. In this experiment, users selected bar type form factors more than slide or flip up ones, because they think that two bar type phones were "more beautiful" even if they prefer slide or flip up phones in an identical situation. Therefore, appearance and aesthetic aspects should be considered quite seriously in further research.

Table 1. Results of sub-experiment

Components	Score	*Zn5*	*Rokr E6*	*Rokr W5*	*A 1200*	*V3xx*	*Rizr Z10*
Colour Brightness	**26**	-	-	-	-	-	-
Col Temperature	**25.5**		-	-	25.5	-	-
Swivel Form factor	**8.5**	-	-	-	-	-	-
Slide Form factor	**16**	-	-	16	16	16	-
Flip up Form factor	**9**	-	-	-	-	-	9
Grid keypad	**4.5**	4.5	4.5	4.5	4.5	4.5	4.5
Additional keys	**5**	5	5	5	5	5	5
Screen Colour	**5.5**	-	-	-	-	-	5.5
Secondary Screen	**4**	-	-	4	-	4	-
Mp3 Ringtone	**3**	3	3	3	3	3	3
SMS	**7**	7	7	7	7	7	7
MMS	**1.5**	1.5	1.5	1.5	1.5	1.5	1.5
Final Score		19.5	19.5	39.5	61	39.5	34
Number of Users who selected the Model		6	6	1	5	1	1

11. Conclusion

Although finding a definition for culture is not easy, available cultural models and related dimensions can be used in cultural customization of mobile devices. Inspired by an integrative approach of the culture-oriented design, the proposed solution in this research can give valuable and detailed information about users' tendencies toward components of mobile communication devices, based on their cultural specifications. The simple and categorised structure of this solution makes its communication with OO configuration systems easier. However, an experiment demonstrated that attention to the combination of these components as "a product" is quite important, and cultural customization is not limited to the selection of the most desirable components (static design) or even the selection of the most pleasurable and usable usage scenarios (dynamic design). "Gestalt" of products is still a dominant factor, while other aspects such as technologic features and virtual entity make the cultural customization process more complex. Further research in this field should address two important areas. First, developing similar solutions for dynamic (behavioural) OO design and the interaction between static design, dynamic design and other parts of an OO configuration system. This can be done by using OO tools such as UML (Unified Modelling Language). A second direction is to find ways for considering aesthetics (in a comprehensive and detailed manner) for cultural customization. As the experiment shows, breaking down the aesthetic characteristics to simple/ raw components such as form factor or colour brightness and temperature would not necessarily end in valid results. Researching available models for analyzing products' aesthetics, and connecting them to the current findings of OO design may provide one of the solutions.

Acknowledgement

The authors would like to appreciate Sana Hajiali, because of her great help in conducting the survey in Tehran.

References

Advanced Visual Interfaces, AVI 2002, Trento, 2002, pp 15-27

Hofstede, G., "Geert Hofstede Cultural Dimensions", Retrieved Sep. 27, 2009 http://www.geert-hofstede.com

Hvam, L., Mortensen, N. H., & Riis, J., "Product Customization", Springer, New York, US, 2008.

Kamppuri, M., Bednarik, R., Tukiainen, M., "The expanding focus of HCI: case culture", Proceedings of the 4th Nordic conference on Human-computer interaction: changing roles, Vol.198, 2006, Oslo, pp 405-408.

Kantar Media Research Group , "Mobile Phone Market Booms in Iran", kmr group update, Early Spring 2007,Vol19,2007,.RetrievedSep.27,2009form:http://www.tgisurveys.com/news/kmrupdate/KMRUpdate19_2.pdf

Kaplan, M., "Introduction: Adding a Cultural Dimension To Human Factors", Advances in Human Performance and Cognitive Engineering Research, Vol. 4,. Elsevier, Amesterdam, 2004, pp XI- XV.

Marcus, A.,. "User-interface design, culture, and the future", Proceedings of the Working Conference on

Rose, K.," The Development of Culture-Oriented Human Machine Systems: Specification, Analysis and Integration of relevant Intercultural Variables", Advances in Human Performance and Cognitive Engineering Research, Vol. 4,. Elsevier, Amesterdam, 2004, pp 61-103

World Bank, "World Development Indicators 2009", World Bank Publications, New York, US, 2009.

Bijan Aryana
PhD research fellow
Norwegian University of Science and Technology/ Department of Product Design
Produktdesign*343, Kolbjørn Hejes vei 2B, 7491 Trondheim, Norway
Telephone: +47 73590115
Email: bijan.aryana@ntnu.no